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CAUSES OF THE FOOD CRISIS 2007−2008 AND PRICE DEVELOPMENT FOR SELECTED COMMODITIES

Strong growth in nominal food prices during the food crisis in 2007−2008 was the first after more than 30 years of steady development of prices for agricultural commodities since the last crisis in the 1970s. The article consists of two parts. The aim of the first part is to give an overview and analyze the causes of the food crisis of 2007−2008. The second part of the paper covers a detailed analysis of price trends for the selected agricultural commodities from January 1998 until May 2011 and an estimate of price trends until December 2011.
Keywords: food crisis, maize, rice, soya beans, grain, time series analysis.
JEL classification: E37, Q02.

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ПРИЧИНИ ХАРЧОВОЇ КРИЗИ 2007−2008 рр. ТА ВІДПОВІДНИЙ РОЗВИТОК ЦІН НА ОБРАНІ ПРОДУКТОВІ ГРУПИ

У статті показано, що суттєве зростання номінальних цін на продукти протягом харчової кризи 2007−2008 рр. було першим таким зростанням після більш ніж 30 років сталого розвитку сільськогосподарських ринків від закінчення аналогічної кризи 1970-их років. У статті представлено групу причин, що призвело до харчової кризи 2007−2008 рр., проведено детальний аналіз динаміки цін на обрану групу харчових продуктів з січня 1998 р. по травень 2011 р., і на основі аналізу побудовано прогнозний тренд до грудня 2011 р., який порівняно з реальними коливаннями цін.
Ключові слова: харчова криза, кукурудза, рис, соєві боби, зерно, аналіз часових рядів.
Табл. 2. Рис. 2. Літ. 14.

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ПРИЧИНЫ ПРОДУКТОВОГО КРИЗИСА 2007−2008 ГГ. И СООТВЕТСТВУЮЩЕЕ РАЗВИТИЕ ЦЕН НА ВЫБРАННЫЕ ГРУППЫ ПРОДУКТОВ

В статье показано, что существенный рост номинальных цен на продукты в течение продуктового кризиса 2007−2008 гг. стал первым таким ростом после более чем 30 лет стабильного развития сельскохозяйственных рынков после окончания аналогичного кризиса в 1970-ых годах. В статье представлена группа причин, которые привели к пищевому кризису 2007−2008 гг., проведен детальный анализ динамики цен на выбранную группу пищевых продуктов с января 1998 г. по май 2011 г., и на основе анализа построено прогнозный тренд до декабря 2011 г., который затем сравнен с реальными колебаниями цен.
Ключевые слова: пищевой кризис, кукуруза, рис, соевые бобы, зерно, анализ временных рядов.
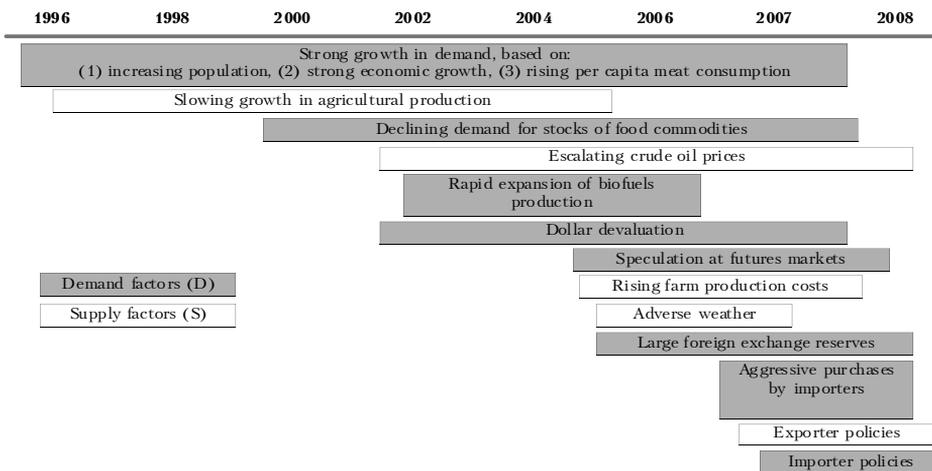
Introduction

In the relatively recent past, world food markets have experienced a substantial rise in prices after more than three decades of a stable development. This sharp increase can be compared only to the rise of prices in the 1970s attributed among other factors to the significant oil price increase. The resulting food crisis of 2007−2008 that followed was in this respect the direct outcome of the sharp prices

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increase, especially for basic food products, connected with depleting food reserves and the shortage of food supply. Due to this, worse access to foodstuffs was experienced by poorer groups of population, thus leading to new humanitarian, socioeconomic, developmental, political, and security challenges by the end of the 20th century for individual nation states as well as for the global community. Even though the consequences of the food crisis were most severe for the poor and developing countries, especially for the countries with low income per capita and for the net importers of agriproducts, which on average spend up to 50−80% of household income on food, significant impacts were felt by larger developing countries like India and China as well the countries of Latin America. The food crisis, however, has not remained without consequences even for the developed countries, where it contributed to inflationary pressures by rising energy prices and fluctuations at financial markets and housing markets that eventually led to the global economic crisis in 2009. The price increase was related to almost all basic food commodities, especially rice, wheat, maize, soya beans, meat, coffee and milk. In some cases food shortages were so severe, that they led to civil unrests in such a diverse range of countries such as Guinea, Mauritania, Mexico, Morocco, Senegal, Uzbekistan and Yemen. In many other countries, especially in India, China and Vietnam, food shortages led to the introduction of emergency measures such as prices control, tax cuts for food retail, the introduction of export duties on grain, export ban on rice and the reduction of import duties on food. All of the above has renewed the global debate on food security.

1. Causes of the food crisis 2007−2008

The causes of the food crisis were quite diverse and it is not possible to narrow them into individual factors without addressing broader issues and consequences of the development at the world commodity markets over time. Due to this reason, we categorized the causes of the food crisis as they have influenced, or have had impact on the price development of food products into long-term factors, medium-term factors and immediate or short-term factors.

Source: Headey, Fan (2010).

Figure 1. **Causes of the food crisis 2007−2008**

However, this categorization should not imply that the factors were isolated in their impacts or that they did not interact. In fact, the whole food crisis should be regarded as a result of the factors' interlap at several different levels. This concept is illustrated by Trostle (2008) slightly extended by Headey and Fan (2010), see Figure 1. The existing literature on this topic is quite extensive and we present in the following literature review the summary of the works by Trostle (2008), Abott, Hurt, Tyner (2009) and Headey and Fan (2008; 2010) and others, all of which we consider to be the basic ones in among other relevant literature sources.

1.1. Long-term factors. The global supply and demand development for food products, that has led to the imbalance at the world food commodity markets and eventually played a strong role in the food crisis of 2007–2008, has been influenced by several long-term factors. The impact outcome of these trends became apparent in slowing growth in production and strengthening the demand. The first factor is the steady population growth over the last 50 years that virtually occurred almost entirely in Asia. While the global trend of population growth slows down, high growth rates can be still seen in the developing countries. This rising population growth amplifies the global demand for agricultural products in conjunction with other aspects.

In this respect, the population growth alone cannot be regarded as the key force behind the supply and demand imbalance. Closely related to the population growth is the issue of agricultural production and productivity decline. After the significant productivity rise in agriculture associated with the green revolution in 1970–1990 amounting to 2.2% per year, the period after 1990 saw an average productivity growth of only 1.3% (Trostle, 2008). Along with the declining productivity growth rates, the aggregate production growth in agriculture in terms of yields has fallen from the average 2.0% per year between 1970–1990 to 1.1% per year between 1990–2007 (Trostle, 2008), while the projection for the future suggests a further decline to less than 1.2% per year over the next 50 years. The growth rate in terms of productivity as well as aggregate production is less than the population growth of developing countries over the last 20 years and will pose a further imbalance of supply and demand at the world food markets as the economic situation in these countries will improve and with rising income a higher demand for food of higher quality will occur.

Within the above perspective, the growing imbalance of supply and demand at the world food markets should be seen also as an indirect result of changing dietary habits and food types consumed around the world. In this respect, a growing consumption of meat can clearly be observed from the 1970s. Especially between 1985 and 1990, meat production was rising more than 3% each year on average, well above the population growth rate of 1.7% in that period. Rising meat consumption in itself is however only an indirect factor to influence the world food prices. The real stress on food prices worldwide is connected with rising meat consumption through commodities used as fodder. This is extensively disproportionate to the aggregate output and can be examined as the feed-to-meat conversion rates, in other words, how much units of feed are needed to produce one unit of meat. The ratio itself varies considerably with different meat types. It is however clear, that with the rising consumption of all meat types, the stress on fodder demand, typically corn, beans, soya beans and wheat, will push the prices upward.

1.2. Medium-term factors. Among the factors that influenced the price develop-
ment of food commodities at the world markets are declining stocks of food globally,
rising oil prices, rising biofuel production and the devaluation of USD. The declining
stocks of food commodities have played a significant role in the medium pre-crisis
period. Although some authors such as Headeay and Fan (2011) argue that the rea-
sons for stocks' declining can be traced back to other factors, the price of food com-
modities at the world markets was nevertheless strongly influenced by the stocks'
decline across all the three major staples – wheat, rice, maize. The reasons can reflect
reduced production and accordingly lead to lower levels of stocks, they can be traced
to exogenous policy decisions such as the high stock level or can reflect the relatively
low prices for food that do not sufficiently constitute the need for higher stocks. It
may therefore seem that the role the declining stocks played was rather indirect.
Nevertheless, lower stocks have led to general shortages at the domestic market caus-
ing the supply-demand imbalance and in some cases even an export ban (India,
Vietnam, and Thailand).

Rising oil prices have, on the other hand, played a more direct role in the devel-
opment of prices for food commodities. While the oil price determines dominantly
transport costs for the world food trade, it is also relevant for operating agricultural
machinery as well as oil-based fertilizers and chemicals used in agricultural produc-
tion. To illustrate this issue, the price index for crude oil has risen by 547% between
1999 and 2008 (Trostle, 2008).

Since crude oil trade is typically denominated in USD, the declining value of this
currency played an important role as well. A depreciating dollar would enable import-
ing countries to actually buy more oil. At the same time, however, it would put more
stress on oil prices as the demand would be rising. But the dollar is important not only
in respect to high oil prices. The US is a major producer of many agricultural prod-
ucts. As the dollar was losing value, the countries importing food commodities from
the US had their import costs declined. This put an upward pressure on food prices
at the domestic food market in the US as the demand for the US food products rose.

Another important factor is biofuels production. Although biofuels were pro-
duced increasingly over several recent decades, production started to rise more rapid-
ly at the turn of the century in the US and the EU. Once the oil price exceeds 60
USD, biofuels become more competitive (Headey, Fan, 2011). The diversion of agri-
cultural production from foodstuffs into biofuels was a very relevant factor influenc-
ing the supply-demand imbalance putting pressure on the domestic markets by cre-
ating a gap in the domestic supply of food commodities. We can draw an example
from the US. It is the largest producer of ethanol from maize and at the same time,
accounts for the two-thirds of global maize exports (Headey, Fan, 2011). The change
in the US production of maize between food and biofuels is therefore likely to affect
international prices.

1.3. Short-term factors. Short-term or immediate factors that have led to the
food crisis in 2007–2008 are also quite diverse and can be attributed to different
developments. In 2004, agricultural production costs began to rise more rapidly, espe-
cially due to energy-related inputs such as fertilizers, fuels, and pesticides. In 2006,
hedge funds, index funds, and sovereign wealth funds became more involved in agri-
cultural commodity markets, although more as a way to diversify the investment port-

folio. This development has led to short-term volatility of food prices at the world commodity markets. The year 2006 was significant also subject to the adverse weather conditions due to which many countries faced reduced crop production, yield losses and severe droughts. This has significantly affected the food stocks and further stressed the supply-demand imbalance.

2. Price analyses for basic agrocommodities

The analysis of time series of agricultural commodities is based on the 3 main tasks:

— description of the time series of the commodity;

— explanation of the evolution of the time series;

— price development forecast until the end of 2011.

In the description of time series we used the descriptive statistics with the basic characteristics (shown in Table 1).

Table 1. **Basic characteristic of commodity price developments**

	Maize	Rice	Soya beans	Wheat
Price in*	USD/t	USD/t	USD/t	USD/t
Type*	US No.2, Yellow, U.S. Gulf (Friday)	White Rice, Thai 100% B second grade, f.o.b. Bangkok (Wednesday)	US No.1, Yellow, U.S. Gulf (Friday)	US No.2, Soft Red Winter Wheat, US Gulf (Tuesday)
Size of dataset	161 months	161 months	161 months	161 months
Minimum price	73.91 (August 2000)	169.5 (April 2001)	168.72 (April 2001)	86.02 (July 1999)
Maximum price	314.06 (April 2011)	962.6 (May 2008)	586.21 (July 2008)	397.24 (March 2008)
Average price	131.52	339.19	285.31	161.69
Median	107.06	293.25	239.47	140.53
Standard deviation	52.85	166.91	107.71	67.76
Average absolute growth	1.20	1.18	1.66	1.11
Average growth rate	1.0062	1.0030	1.0045	1.0054

* FAO Trade and Markets:
http://www.fao.org/es/esc/prices/PricesServlet.jsp?lang=en&ccode=2311.
Source: own calculations based on FAO Trade and Markets:
http://www.fao.org/es/esc/prices/PricesServlet.jsp?lang=en&ccode=2311.

We analyzed the four basic commodities: maize, wheat, rice and soya beans. In analyzing the basic characteristics of the evolution of prices of these commodities we used the average monthly nominal prices for the period January 1998 to May 2011 (based on the online statistical database provided by the FAO). The size of the data set for each commodity is 161. The minimum price for each commodity was obtained between July 1999 (wheat) to April 2001 (rice and soya beans). Concerning the maximum price, it is possible to observe a significant difference between maize and other commodities. While the maximum average monthly prices for wheat, rice and soya bean have been achieved during the months from March to July 2008, in case of maize, the maximum price was reached in April 2011 (in March-July 2008 the price ranged on average 255.60 USD/ton which is about 81.4% of the level of April 2011). When comparing the average monthly prices and the median identical fact can be

observed when the average price is higher than the median, suggesting an asymmetrical distribution of commodity prices in favor of lower than average prices. The average absolute growth in period in review was the highest for soya beans (USD 1.66/ton month) and the lowest for wheat (USD 1.11/ton month). Concerning the average growth rate of prices, rice showed the lowest (0.3% month on month) and maize showed the highest (0.62% month on month).

Given the fact that commodity prices are asymmetrically distributed, it is possible to observe a varying incidence of prices deviating from the average price if we consider the multiplication of the standard deviation[2]. The frequency of prices in each price class is determined by the difference of multiples of the standard deviation from the average price. Within the interval $y\pm\sigma$ more than 80% of prices for maize and wheat can be observed and more than 75% of prices of rice and soya beans. On the other hand, it is possible to observe the occurrence of abnormally high prices for maize (1.86% prices), wheat (1.24% of price) and rice (1.86% prices) higher than $y+3*\sigma$. As regards the minimum price ($y-2*\sigma$), it is possible to observe higher frequency in the case of wheat (4.3% of prices) and soya beans (6.21% of prices). Extremely low prices (lower than $y-2*\sigma$) did not occur during the period in review. Based on the data, it can be stated that during the selected period, most prices fluctuated at around the average price (depending on the level of the standard deviation) with the exception of 2008 when extremely high levels of prices for all commodities were achieved (in the case of maize also in the first half of 2011).
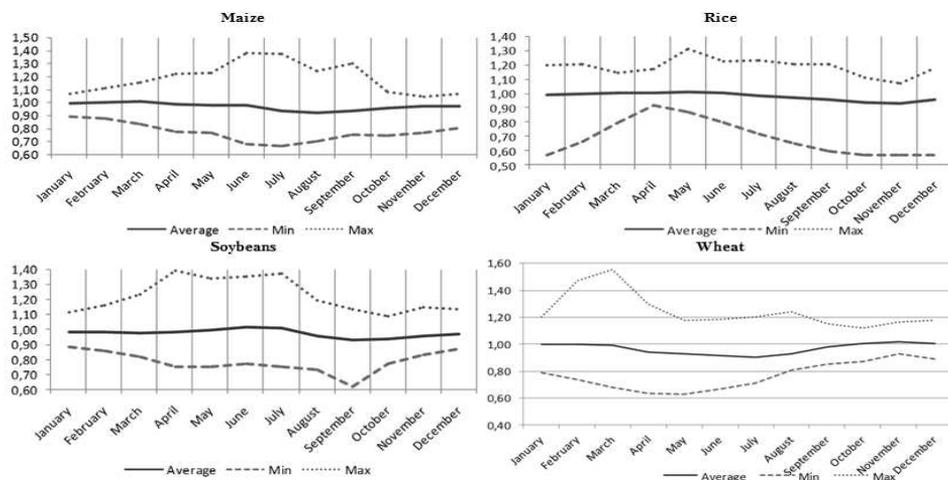
2.1. Analysis of price developments. Concerning the evolution of the time series, we decomposed the time series for individual agrocommodities into two main components: 1. Trend component; and 2. Seasonal component.

For the trend component, we chose moving quarterly averages which copy the actual prices for each year almost exactly (if using moving annual averages there is a higher degree of discrepancy between the forecast and reality in the case of extreme prices of 2008). Models for individual commodities explain only 63.12% (wheat) – 74.17% (soya bean) price variability. For all the commodities, however, the reliability value R2 is higher for the forecast on average by 1.71% (maximum deviation from the reliability of the forecast has rice (difference +2.7%) and lowest maize (+1%)).

In the decomposition of time series, we also analyzed the seasonal component in the development of commodity prices. Based on the size of the standard deviation calculated from the monthly indices we assume that the credibility of the seasonal component is sufficiently high. Based on the data (Figure 2), we see that the lowest average price for maize was achieved in the months July to September (below 7% on average) and the highest prices can be expected in March (0.3% higher than average) and February (-0.2% below average). In the months from October to January there is a gradual increase in the prices. Stable prices (the lowest variability) can be expected in the months from January to February and from October to December. In summer, the variability is much higher, reaching the highest values in June and July. In the case of rice, the highest drop in prices can be seen in the months from October to December (on average 6% below the average price), which is distinct from wheat

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[2] In the case of normal distribution 68% of the measured values lie in the interval $y\pm\sigma$, 95% of the measured values lie in the interval $y\pm2*\sigma$, and 99.73% of the measured values lie the interval $y\pm3*\sigma$.

(wheat reaches the highest prices in these months). The highest prices may be seen in the months April to June by the average of 0.3% above the average price. The highest difference between the prices can be observed in January, September, and December, stable development of prices in March and April. Similar development as maize can be observed also in wheat, with the exception of winter months. The lowest prices are reached in the months from May to August (on average below the average price by 8.25%). Unlike maize, wheat reaches the highest prices in the months from October to December (1% above average). In these months it is possible to observe stable prices with the lowest variability. Conversely, the highest change is seen in the months of February and March. As for soya beans, it shows a similar trend as rice in autumn and winter months, while the lowest average price was reached in September and October (-7% from the average). The highest prices were reached, like in rice, in the summer months of June and July (1.5% above the average). The highest price difference occurred in the months April to July, the lowest differences − in the months from January to February and from November to December.

Source: own calculations.

Figure 2. **Seasonal components for the selected agrocommodities**

2.2. *Estimation of price developments.* When estimating the commodity price trends, we used trend and seasonal components of time series modelling, while for the expression of seasonality we used artificial variables. To reflect the trend we applied a third-degree polynomial. The value of reliability R2 in the case of forecasts ranges from 97.99% for wheat to 99.57% for rice, which means that our forecast models are robust enough to explain the variability of commodity price developments.

The final forecasting equations for selected agrocommodities are as follows:

Maize:

$y = -2 * 10^{-5}x^3 + 0,0133x^2 - 0,928x + 106,56$

Rice:

$y = -0,006x^3 + 0,1776x^2 - 12,309x + 411,15$

Soya beans:

$y = -0,0001x^3 + 0,046x^2 - 2,8827x + 240,27$

Wheat:

$$y = -8 * 10^{-5}x^3 + 0{,}024x^2 - 1{,}0199x + 113{,}12$$

Conclusion

Table 2 shows the estimated prices for commodities for the months from June to December 2011. Based on the model we assumed a slight decline in maize prices in the months of July and August with an increase from September to December. In reality, the price of maize slightly rose from July to August and decreased gradually from September to December. The price of rice was projected to decline in the months from July to November with the growth in December. In spite of the forecasted price, the actual price of rice continually increased with a sharp decline in December. Regarding the soya beans, the model expected prices to decrease in August compared to July, with a gradual decline until September and growth in prices from October to December. Actual price of soya beans followed the forecasted trend until September, from October to December soya beans experienced the decline in the price. For wheat, we expected a gradual rise in prices throughout the forecast period. In reality, there was a decline in the price from October until December similar to the decline of soya beans price.

Table 2. **Estimation of commodity prices from June to December 2011, USD/ton**

	Maize			Rice		
	Forecast	Reality	Difference, %	Forecast	Reality	Difference, %
June	243,38	314,21	-22,54	583,44	518,50	12,52
July	239,14	301,74	-20,75	576,33	548,20	5,13
August	238,74	308,38	-22,58	566,99	582,25	-2,62
September	243,15	305,63	-20,44	561,85	617,75	-9,05
October	246,49	274,79	-10,30	548,93	620,25	-11,50
November	250,51	278,02	-9,89	543,32	648,75	-16,25
December	253,79	259,50	-2,20	550,00	619,60	-11,23
	Soybeans			Wheat		
	Forecast	Reality	Difference, %	Forecast	Reality	Difference, %
June	503,93	529,28	-4,79	249,20	295,51	-15,67
July	502,19	528,04	-4,90	249,13	263,93	-5,61
August	487,04	523,29	-6,93	255,15	277,11	-7,92
September	480,51	497,17	-3,35	265,72	273,86	-2,97
October	483,89	467,42	3,52	268,25	254,74	5,30
November	495,01	451,00	9,76	271,13	258,83	4,75
December	504,11	446,08	13,01	274,16	245,92	11,48

Source: own calculations; FAO Trade and Markets:
http://www.fao.org/es/esc/prices/PricesServlet.jsp?lang=en&ccode=2311.

The trend in actual nominal commodity prices does not exactly copy the trend that we predicted based on our set of models. This points to the fact that the prices of selected agrocommodities are not only affected by the development of past prices, but also by other factors of influence analyzed in the first part of this article. The aim of this paper was to analyze the prices of individual agrocommodities on the basis of their past developments and provide the simplest possible models for predicting prices in the short term; therefore we did not focus on creating econometric models using multiple variables, which might be better in explaining the price variability in recent years.

In the view of the above, we suggest that more research is needed on the price developments of agrocommodities that will contribute to the overall analysis of the factors impacting the prices of agricultural commodities, in order to prevent future similar unexpected price increases like in the years 2007—2008.

References:

Abbot, P. C., Hurt, C., Tyner, W. E. (2009). What's Driving Food Prices? [online]. Farm Foundation Issue Report, March 2009 Update. http://ageconsearch.umn.edu/bitstream/48495/2/FINAL%203-10-09%20-%20Food%20Prices%20Update.pdf.

Bhaskar, A., Ahmed, A.U., Shariff, A. (2009). Causes and consequences of the recent food price inflation and the role of social protection in mitigating the impact: A literature review. Report prepared for the Asian Development Bank. Washington, D.C.: International Food Policy Research Institute.

Csabay, M. et al. (2011). Ekonomika rozvojovych statov. Bratislava: Vydavatelstvo EKONOM. ISBN 978-80-225-3129-0.

Dudas, T. eta al. (2011). Svetova ekonomika — sektorovy aspekt. Bratislava: Vydavatelstvo EKONOM. ISBN 978-80-225-3177-1.

FAO Trade and Markets. [online] http://www.fao.org/es/esc/prices/PricesServlet.jsp?lang=en&ccode=2311.

Fuglie, K. (2008). Is a slowdown in agricultural productivity growth contributing to the rise in commodity prices? Agricultural Economics, 39: 431—441.

Headey, D. Fan, S. (2008). Anatomy of a crisis: The causes and consequences of surging food prices. Agricultural Economics, 39 (supplement): 375—391.

Headey, D., Fan, S. (2010). Reflections on the Global Food Crisis: How Did It Happen? How Has It Hurt? And How Can We Prevent the Next One? [online]. International Food Policy Research Institute. http://www.ifpri.org/sites/default/files/publications/rr165.pdf.

Ivanic, M., Martin, W. (2008). Implications of higher global food prices for poverty in low-income countries. Agricultural Economics, 39: 405—416.

Lipkova, L. et al. (2005). Ekonomika rozvojovych statov. Bratislava: Vydavatelstvo EKONOM.

Robles, M., Cooke, B. (2009). Recent food prices movements: A time series analysis. Discussion Paper 942. Washington, D.C.: International Food Policy Research Institute.

Rosegrant, M. W. Zhu, T., Msangi, S., Sulser, T. (2008). The impact of biofuel production on world cereal prices. Washington, D.C.: International Food Policy Research Institute.

Trostle, R. (2008). Global Agricultural Supply and Demand: Factors Contributing to the Recent Increase in Food Commodity Prices [online]. A Report from the Economic Research Service, WRS-0801. July 2008. http://www.ers.usda.gov/Publications/WRS0801/WRS0801.pdf.

Von Braun, J. (2008). High and rising food prices: Why are they rising, who is affected, how are they affected, and what should be done? Washington, D.C. [online] http://www.ifpri.org/presentations/20080411jvbfoodprices.pdf.

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